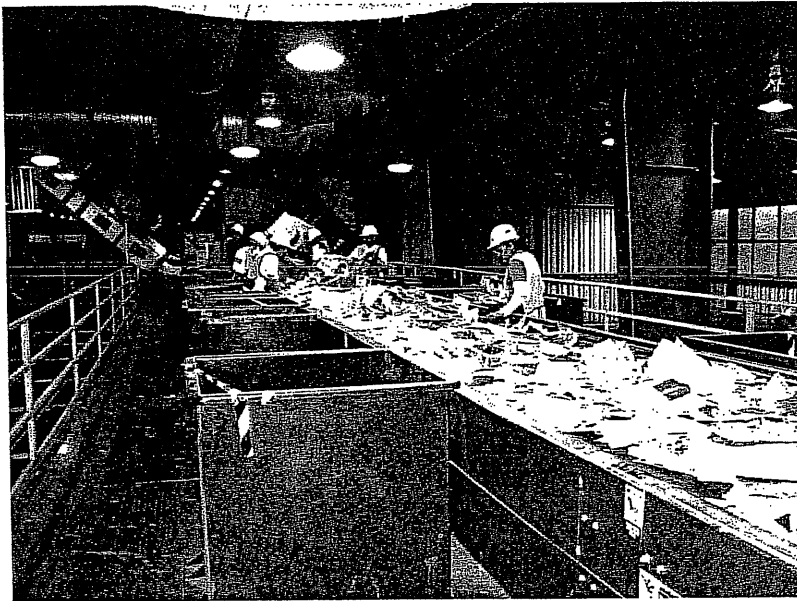


# EXHIBIT K

Final Report | May 2003



## Waste Characterization Methodology for Determining Allocation of Curbside Recycling Revenues

City of Sunnyvale

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# Section 1

## Introduction

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Brown, Vence and Associates (BVA) was retained by the City of Sunnyvale (Sunnyvale) in association with the Cities of Mountain View and Palo Alto to conduct a Study to develop a waste characterization methodology for source-separated recyclables. This methodology will be used in the process of allocating SMaRT Station ® revenues to each of the cities in accordance with the Memorandum of Understanding, and the Revenue Allocation Methodology approved by the Cities in January, 2002 (See Appendix E). The Study included:

- Meeting with the cities and haulers to collect data and discuss field sampling logistics
- Developing a comprehensive composition analysis methodology
- Preparing a training manual for future characterizations to be performed by SMaRT Station contractor
- Providing training to the staff and contractor during the field sampling
- Conducting field sampling
- Analyzing and presenting the results

The purpose of the study was to develop and implement a waste characterization methodology to determine the amounts and concentrations of each curbside material delivered to the SMaRT Station by each of the two cities.

BVA conducted the Study in three phases: initial planning, field sampling analyses, and report preparation. Initial planning occurred prior to the field sampling analyses in February and early March 2003. We held a kick-off meeting at the SMaRT Station with Sunnyvale Staff and the Contract Operator. BVA also met with Green Team/Zanker (GTZ) to discuss the overall Study approach, collect relevant data, and make contacts. A follow-up meeting was held with both cities and their haulers; Specialty Solid Waste & Recycling (Specialty) for Sunnyvale and Foothill Disposal Company (Foothill) for Mt View. During this initial planning phase a draft methodology and training manual were developed. In addition, all logistics for the field sampling phase were performed.



## Section 1

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BVA conducted the actual field sampling analyses from March 22, 2003 through April 4, 2003, collecting a total of 40 samples from both cities. Materials were characterized during the field sampling using randomly pre-selected loads. These loads were sorted and processed by individual truck compartment using the SMaRT Station's curbside processing equipment and GTZ's normal processing staff. Details to the exact methodology are included in the following report sections.

Data collected during the field sampling analyses were sorted and summarized by city, load type, and truck compartment. Statistics were applied to the results to calculate the mean, standard deviation, and margins of error at a 90-percent confidence level for each of the curbside materials collected.

The report describes each of the initial planning, field sampling analyses, and report phases through the supporting procedures and findings. Section 2 discusses the Study's procedures, and Section 3 presents the findings of the Study, including all pertinent tables and statistics. Appendix A contains the methodology and Appendix B includes a step-by-step training manual.

# Section 2

## Study Procedures

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Brown, Vence and Associates (BVA) followed the Methodology and Training Manual procedures described within this report in conducting the Study. We have highlighted specific procedure details developed in particular for the Study and Field Sampling Analyses conducted over the period of February through April 2003 in this section.

### 2.1 Phase I: Initial Planning

#### Sampling Plan

As discussed, a total of 40 samples, 20 samples for Sunnyvale and 20 samples for Mt View were selected. Next, a selection of the type of routes to be sampled for each city was performed. Specialty runs three types of routes for Sunnyvale. These three routes to divide the sampling across include; (1) single-family residential (SF), (2) multi-family residential (MF) and, (3) schools/City Hall. Foothill runs three types of routes for Mt View. These three routes to divide the sampling across include; (1) residential, (2) commercial and, (3) OCC. Specialty runs a total of 32 routes to cover the entire city of Sunnyvale, while Foothill runs 68 routes to cover the entire city of Mt View. To calculate the number of samples required by route type, the total number of a specific route type was divided into the total routes for each individual city. The number of routes by city, route type, percentage of routes and number of samples required by route is shown in Table 2-1.

#### Schedule

A schedule was developed to allow, as best possible, uninterrupted curbside processing operations at the SMaRT Station. The schedule also had to cover each day of the week (Monday through Friday) collection occurred equally. The schedule also took into account each hauler's route list and geographic representation. Routes were then selected randomly for each day from this list. As discussed, loads were held overnight from the previous day's collection activities and delivered to the SMaRT Station between 5:00 am and 8:00 am



## Section 2

each day (except for the initial day when all loads were scheduled an hour later to take into account training and start-up activities). In a meeting with cities haulers, it was decided that Specialty would take the earliest and latest deliveries of the day, while Foothill took the two mid-time deliveries. The actual delivery schedule is shown in Table 2-2.

**Table 2-1 | Route Sampling Plan**

| City/Route              | Number of Routes | Percentage by Routes | Number of Samples |
|-------------------------|------------------|----------------------|-------------------|
| <b><u>Sunnyvale</u></b> |                  |                      |                   |
| SF Residential          | 25               | 78%                  | 15                |
| MF Residential          | 6                | 19%                  | 4                 |
| Schools/City Hall       | <u>1</u>         | <u>3%</u>            | <u>1</u>          |
| <b>Totals</b>           | <b>32</b>        | <b>100%</b>          | <b>20</b>         |
| <b><u>Mt View</u></b>   |                  |                      |                   |
| Residential             | 41               | 60%                  | 12                |
| Commercial              | 20               | 29%                  | 6                 |
| OCC                     | <u>7</u>         | <u>10%</u>           | <u>2</u>          |
| <b>Totals</b>           | <b>68</b>        | <b>100%</b>          | <b>20</b>         |

Table 2-2 | Study Route Delivery Schedule

| Materials Collected on: | Fri 3/21             | Mon 3/24             | Tue 3/25             | Wed 3/26             | Thu 3/27             | Fri 3/28             | Mon 3/31             | Tue 4/1              | Wed 4/2              | Thu 4/3              |
|-------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Delivered to SMaRT on:  | Sat 3/22             | Tue 3/25             | Wed 3/26             | Thu 3/27             | Fri 3/28             | Sat 3/29             | Tue 4/1              | Wed 4/2              | Thu 4/3              | Fri 4/4              |
| 5:00 AM                 |                      | Specialty SF - 703   | Specialty SF - 704   | Specialty SF - 701   | Specialty SF - 702   | Specialty SF - 701   | Specialty SF - 704   | Specialty SF - 705   | Specialty SF - 702   | Specialty SF - 701   |
| 5:30 AM                 |                      | Foothill COM - 11134 |                      | Foothill COM - 11139 |                      | Foothill COM - 11102 |                      | Foothill COM - 11139 | Foothill COM - 11155 | Foothill COM - 11102 |
| 6:00 AM                 | Specialty SF - 702   |                      | Foothill RES - 15096 |                      | Foothill RES - 15097 |                      | Foothill RES - 15097 |                      |                      |                      |
| 7:00 AM                 | Foothill OCC - 18    | Foothill RES - 15097 | Foothill RES - 15095 | Foothill RES - 15098 | Foothill RES - 15095 | Foothill RES - 15098 | Foothill OCC - 18    | Foothill RES - 15098 | Foothill RES - 15095 | Foothill RES - 15096 |
| 8:00 AM                 | Foothill RES - 15096 | Specialty SF - 705   | Specialty 615        | Specialty MF - 706** | Specialty SF - 704   | Specialty SF - 705   | Specialty MF - 707   | Specialty SF - 701   | Specialty SF - 703   | Specialty MF - 706** |
| 9:00 AM                 | Specialty MF - 706   |                      |                      |                      |                      |                      |                      |                      |                      |                      |

## Equipment and Crew Preparation

Prior to the actual field sampling analyses, we met with the cities, their haulers and the contract operator, GTZ. The haulers, with support from their cities agreed to the schedule described above. GTZ agreed to make available all crew and equipment normally used in their day-to-day curbside processing operations. The crew for the initial Study consisted of approximately 36 personnel including approximately 17 curbside line sorters, 15 commercial line sorters, two rolling stock (forklift and front-end loader) operators, one part-time baler operator, and one floor manager. The normal truck-scale assistant was not usually on duty during our Study (the floor manager recorded scale weights). Equipment supplied by GTZ included at least two forklifts, a front-end loader, and various bins and containers to collect and store samples. Additional BVA supplied: a laptop computer to log all information from the study, flagging tape, three ½-gallon containers to collect liquids, permanent markers, duct tape, and notebooks. Personal safety equipment such as hardhats, safety vests, goggles,

earplugs etc were supplied by the contractor's crew for the crew (this is equipment that they use on a daily basis to perform their job).

## 2.2 Phase II: Field Sampling Analyses

### Equipment Setup

Equipment setup was performed at the beginning of each and every day sampling was to occur. Setup included:

- Setting up the table and chair for the laptop computer and BVA data entry personnel near the platform scale, but out of the way of the facility operations.
- Starting up the laptop computer and readying the blank sample sheets for each day of testing (2 sheets for each city; 4 sheets total).
- Sweeping and cleaning up around the platform and truck scale area; zeroing out the scale
- Tape off areas on sorting platforms that sorters should not sort into; for container line tape one strip of caution tape across all normal bunker openings; for fiber line put caution tape over bunker chutes not in use (third and fourth bunker from in-feed, these will be used for storage).
- Check all lines to see if clear of all materials including all in-feeds, conveyor systems, sorting line containers, floor bins, bunker areas.
- Have crew clean up and sweep around all conveyor systems.
- Check tare weights on all containers and bins; apply duct tape to containers/bins and add with permanent marker the first letter of the day of sampling and the tare of the container/bin.
- Ensure that if bales are located on the balers, the last bale is marked to designate where the study loads will begin.
- Place three (3) extra bins for sort under/adjacent to the containers sorting line; these bins include: (1) aluminum cans, (2) PET, and (3) HDPE.
- Tie off residue screening material at bottom from air classification system; not much residue is gathered per run and can easily be untied and emptied into a small container at the end of each run.



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## Sampling Procedures

Field sampling began on Saturday March 22<sup>nd</sup> and ran through Friday April 4<sup>th</sup>. Sampling was conducted on Tuesdays through Saturdays for the two-week period; a total of 10 sampling days. Sampling began most all days (except the first) at 5:00 am and continued until all 4 samples for the day were processed. Sampling continued each day until approximately 10am to 11am. BVA found that this did not interfere much with normal curbside vehicle unloading and processing patterns.

Detailed sampling procedures are included in the Training Manual in Appendix B. A copy of this document is provided in Spanish in Appendix C. We have included a copy of our daily hand-written field notes in Appendix D.

As can be expected, some variations to the normal sampling procedures occurred throughout the Field Study period. These included:

- On March 22<sup>nd</sup>, first day of the sort, contract sorting team utilized more than the normal allotment of sorters for approximately the first 5 minutes of the first two loads (one Sunnyvale, the other Mt View).
- On March 26<sup>th</sup>, first Specialty truck's compactor unit froze; the first Foothill load was processed in its place (then the Specialty load was dumped and processed); during the same day, a container of HDPE was dumped before weighing occurred; a comparable amount was measured, weighed and added to the load.
- On March 28<sup>th</sup>, the first Foothill load was delivered using a 2-compartment truck instead of the usual 3-compartment truck; Foothill explained that the selected route is a normal Thursday route in which they use a smaller truck to access more difficult/narrower customer routes.
- On April 1<sup>st</sup>, a customer's broken toter was found in the first Foothill load in the newspaper compartment; the container was weighed as residue; a third and new forklift driver was introduced to the Study this day; he brought several containers of previously weighed materials to the scales to be weighed and recorded; these erroneous container weights were not entered into the spreadsheet (however one container needed backing out

of the spreadsheet); three forklift drivers is too many for the sort (2 is perfect).

- On April 3<sup>rd</sup>, the first Specialty truck dumped only half of its container load for processing; the remainder of the load which was stuck in the compartment was later dumped onto the tip floor and then transferred back for processing; no final tare weight for this vehicle was recorded; the final tare weight was calculated by subtracting the weight of material dumped onto the floor from the truck's final weight.

## 2.3 Phase III: Report Preparation

### Review and Reconcile Data

All data was entered directly into an Microsoft Excel spreadsheet on the laptop computer in the field during the Study. All data was error checked after each route was sampled to check for shrinkage and possible errors. In addition, all data was checked and reconciled at the end of the Study as well.

### Generate Statistics and Summary Tables

Tables were generated by city, by load type and by truck compartment type. All data was reported in weight (lbs) and percentage. A summary table was developed by aggregating material type for all loads from each city for statistical analysis. The mean, standard deviation and margin of error at a 90% confidence level was computed for each material type. To calculate the composition between the two cities, a weighting of the loads by number sampled of each type to the amount normally delivered over the two-week sampling period was conducted. Results are provided in Section 3 of the report.

### Report of Procedures and Findings

This report represents the documentation of procedures prepared containing sufficient detail so that a person familiar with the design of the SMaRT Station, and a copy of the Methodology and Training Manual included in this report could replicate the Study. The report includes comments on aspects of the Study that presented special difficulties or would be difficult to replicate, and a written explanation of the findings shown in the summary tables.

# Section 3

## Findings

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This section describes the Study's findings through presentation and discussion of resultant tables. The total weights and percentages of each material component for all 20 samples per city and by truck compartment were first accumulated. Next, tables were developed to summarize samples from "like" routes for each city. This included addressing: 1) residential and 2) schools/City Hall routes for the City of Sunnyvale and 1) residential 2) commercial and 3) OCC routes for the City of Mountain View. We also summarized data on Sunnyvale's residential routes by single-family and multi-family routes. Next an over all composition summary and statistical analysis was applied to the average percent composition by material type for each city. The analysis included calculating the mean, standard deviation and margin of error for each material. In addition to the tables presented in this section, Appendix F contains support calculations and tables.

### 3.1 Sunnyvale

Table 3-1 presents a summary of the average percent composition by material type and truck compartment (commingled containers and fiber compartments) from the 20 samples analyzed for the City of Sunnyvale during the Study. This table shows that for the residential routes, the largest component in the comingled containers truck compartment was mixed glass at 37.4% and in the fiber truck compartment, old newspaper at 86.5%. This table also shows that for the schools/city hall routes, the largest component in the comingled containers truck compartment was tin cans at 31.1% and in the fiber truck compartment, old corrugated cardboard at 100%.

### 3.2 Mountain View

Table 3-2 presents a summary of the average percent composition by material type and truck compartment (commingled containers, newspaper and mixed paper compartments) from the 20 samples analyzed for the City of Mountain View during the Study. This table shows that for the residential routes, the



largest component in the commingled containers truck compartment was mixed glass at 35.2%, the largest component in the newspaper truck compartment was old newspaper at 97.6%, and the mixed paper truck compartment, mixed paper at 99.0%. This table also shows that for the commercial routes, the largest component in the single truck compartment was mixed paper at 68.2%. For the OCC routes, OCC made up an average of 97% of the truck's load, the remainder was classified as residue.

### 3.3 Statistical Analyses

Table 3-3 presents a statistical analysis of the percent composition by component for each city. The analysis included development of the mean, standard deviation and margin of error at a 90% confidence level. For Sunnyvale, most all components had a margin of error of 1% or less except for ONP and mixed paper. The margin of errors for these components was 5.6% and 8.1% respectively. The higher margin of error for these two components was due to the one different type of load, the schools/City Hall load which had 0% ONP and 97.3% mixed paper (very different from Sunnyvale's residential routes).

For Mountain View, most components had a margin of error of 1% or less except for ONP, OCC and mixed paper. The margin of errors for these components was 5.2%, 8.1% and 11.9% respectively. The higher margin of error for these fiber components was due to statistically analyzing the mixture of commercial and OCC routes with those of the residential. The commercial and OCC routes had a much higher concentration of fibers.

Table 3-1 | Sunnyvale Summary by Route Type

|                                       | Residential<br>Route<br>Totals | Schools/<br>City Hall<br>Route<br>Totals |
|---------------------------------------|--------------------------------|--|
| <b>Characterization by Percentage</b> |                                |  |
| <b><u>Commingled Containers</u></b>   | <b><u>Ave (%)</u></b>          | <b><u>Ave (%)</u></b>                    |
| Tin Cans                              | 8.2%                           | 31.1%                                    |
| PET                                   | 6.8%                           | 11.1%                                    |
| HDPE - Mix                            | 7.9%                           | 12.2%                                    |
| Aluminum Cans                         | 2.3%                           | 7.8%                                     |
| Glass Bottles - Clear                 | 10.3%                          | 6.7%                                     |
| Glass Bottles - Green                 | 9.9%                           | 0.0%                                     |
| Glass Bottles - Brown                 | 4.5%                           | 0.0%                                     |
| Glass Bottles - Mix                   | 37.4%                          | 0.0%                                     |
| Liquid                                | 0.4%                           | 3.3%                                     |
| Residue                               | 11.1%                          | 10.0%                                    |
| Shrinkage                             | <u>1.1%</u>                    | <u>17.8%</u>                             |
| Total Container Compartment           | 100.0%                         | 100.0%                                   |
| <b><u>Fiber</u></b>                   | <b><u>Ave (%)</u></b>          | <b><u>Ave (%)</u></b>                    |
| Old Newspaper                         | 86.5%                          | 0.0%                                     |
| Mixed Paper                           | 6.0%                           | 100.3%                                   |
| Old Corrugated Cardboard              | 6.0%                           | 0.0%                                     |
| Tin Cans                              | 0.1%                           | 0.0%                                     |
| PET                                   | 0.1%                           | 0.0%                                     |
| HDPE - Mix                            | 0.1%                           | 0.0%                                     |
| Aluminum Cans                         | 0.0%                           | 0.0%                                     |
| Glass Bottles - Clear                 | 0.0%                           | 0.0%                                     |
| Glass Bottles - Green                 | 0.0%                           | 0.0%                                     |
| Glass Bottles - Brown                 | 0.0%                           | 0.0%                                     |
| Glass Bottles - Mix                   | 0.3%                           | 0.0%                                     |
| Liquid                                | 0.0%                           | 0.0%                                     |
| Residue                               | 0.4%                           | 0.0%                                     |
| Shrinkage                             | <u>0.5%</u>                    | <u>-0.3%</u>                             |
| Total Fiber Compartment               | 100.0%                         | 100.0%                                   |



## Section 3

**Table 3-2 | Mountain View Summary by Route Type**

|  | <b>Residential</b>    | <b>Commercial</b>     | <b>OCC</b>            |
|--|-----------------------|-----------------------|-----------------------|
|  | <b>Route</b>          | <b>Route</b>          | <b>Route</b>          |
|  | <b>Totals</b>         | <b>Totals</b>         | <b>Totals</b>         |
| <b>Characterization by Percentage</b>      |                       |                       |                       |
| <b><u>Commingled Containers</u></b>        | <b><u>Ave (%)</u></b> | <b><u>Ave (%)</u></b> | <b><u>Ave (%)</u></b> |
| Tin Cans                                   | 6.9%                  | n/a                   | n/a                   |
| PET  | 6.3%                  | n/a                   | n/a                   |
| HDPE - Natural                             | 0.0%                  | n/a                   | n/a                   |
| HDPE - Color                               | 0.0%                  | n/a                   | n/a                   |
| HDPE - Mix                                 | 6.4%                  | n/a                   | n/a                   |
| Aluminum Cans                              | 1.9%                  | n/a                   | n/a                   |
| Scrap Metal                                | 0.0%                  | n/a                   | n/a                   |
| Glass Bottles - Clear                      | 10.7%                 | n/a                   | n/a                   |
| Glass Bottles - Green                      | 13.6%                 | n/a                   | n/a                   |
| Glass Bottles - Brown                      | 5.7%                  | n/a                   | n/a                   |
| Glass Bottles - Mix                        | 35.2%                 | n/a                   | n/a                   |
| Liquid                                     | 0.3%                  | n/a                   | n/a                   |
| Residue                                    | 11.7%                 | n/a                   | n/a                   |
| Shrinkage                                  | <u>1.2%</u>           | <u>n/a</u>            | <u>n/a</u>            |
| Total Container Compartment                | 100.0%                | n/a                   | n/a                   |
| <b><u>Newspaper/Single Compartment</u></b> | <b><u>Ave (%)</u></b> | <b><u>Ave (%)</u></b> | <b><u>Ave (%)</u></b> |
| Old Newspaper                              | 97.6%                 | 0.0%                  | 0.0%                  |
| Mixed Paper                                | 2.5%                  | 68.2%                 | 0.0%                  |
| Old Corrugated Cardboard                   | 0.0%                  | 20.4%                 | 97.0%                 |
| Tin Cans                                   | 0.0%                  | 0.8%                  | 0.0%                  |
| PET  | 0.0%                  | 0.3%                  | 0.0%                  |
| HDPE - Natural                             | 0.0%                  | 0.0%                  | 0.0%                  |
| HDPE - Color                               | 0.0%                  | 0.0%                  | 0.0%                  |
| HDPE - Mix                                 | 0.0%                  | 0.3%                  | 0.0%                  |
| Aluminum Cans                              | 0.0%                  | 0.3%                  | 0.0%                  |
| Scrap Metal                                | 0.0%                  | 0.0%                  | 0.0%                  |
| Glass Bottles - Clear                      | 0.0%                  | 0.0%                  | 0.0%                  |
| Glass Bottles - Green                      | 0.0%                  | 0.0%                  | 0.0%                  |
| Glass Bottles - Brown                      | 0.0%                  | 0.0%                  | 0.0%                  |
| Glass Bottles - Mix                        | 0.0%                  | 2.2%                  | 0.0%                  |
| Liquid                                     | 0.0%                  | 0.0%                  | 0.0%                  |
| Residue                                    | 0.2%                  | 7.5%                  | 3.3%                  |
| Shrinkage                                  | <u>-0.4%</u>          | <u>0.0%</u>           | <u>-0.3%</u>          |
| Total Newspaper Compartment                | 100.0%                | 100.0%                | 100.0%                |

### Section 3

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**Table 3-2 | Mountain View Summary by Route Type (Continued)**

|                               | <b>Residential<br/>Route<br/>Totals</b> | <b>Commercial<br/>Route<br/>Totals</b> | <b>OCC<br/>Route<br/>Totals</b> |
|-------------------------------|---|--|---------------------------------|
| <b>Mixed Paper</b>            | <b><u>Ave (%)</u></b>                   | <b><u>Ave (%)</u></b>                  | <b><u>Ave (%)</u></b>           |
| Old Newspaper                 | 0.0%                                    | n/a                                    | n/a                             |
| Mixed Paper                   | 99.0%                                   | n/a                                    | n/a                             |
| Old Corrugated Cardboard      | 0.0%                                    | n/a                                    | n/a                             |
| Tin Cans                      | 0.0%                                    | n/a                                    | n/a                             |
| PET                           | 0.0%                                    | n/a                                    | n/a                             |
| HDPE - Natural                | 0.0%                                    | n/a                                    | n/a                             |
| HDPE - Color                  | 0.0%                                    | n/a                                    | n/a                             |
| HDPE - Mix                    | 0.0%                                    | n/a                                    | n/a                             |
| Aluminum Cans                 | 0.0%                                    | n/a                                    | n/a                             |
| Scrap Metal                   | 0.0%                                    | n/a                                    | n/a                             |
| Glass Bottles - Clear         | 0.0%                                    | n/a                                    | n/a                             |
| Glass Bottles - Green         | 0.0%                                    | n/a                                    | n/a                             |
| Glass Bottles - Brown         | 0.0%                                    | n/a                                    | n/a                             |
| Glass Bottles - Mix           | 0.0%                                    | n/a                                    | n/a                             |
| Liquid                        | 0.0%                                    | n/a                                    | n/a                             |
| Residue                       | 0.0%                                    | n/a                                    | n/a                             |
| Shrinkage                     | <u>1.0%</u>                             | <u>n/a</u>                             | <u>n/a</u>                      |
| Total Mixed Paper Compartment | 100.0%                                  | n/a                                    | n/a                             |

Table 3-3 | Study Summary With Statistics

[illegible]



# Appendix A

## Methodology

# Methodology

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## Introduction

The following methodology was developed to address characterization of the source separated recyclable materials stream that is currently collected by the franchised haulers for the cities of Sunnyvale and Mountain View and delivered to the SMaRT Station (Facility) for processing.

Sunnyvale utilizes a curbside processing system at the Facility to receive, process, and separate out recyclable materials for market from source separated and commingled recyclables. These recyclables are set out at the curb by Mountain View and Sunnyvale participants. Palo Alto does not use the Facility's curbside processing system as it currently utilizes a processing system located at the Palo Alto Landfill.

## Background Information

### Current Collection System

Sunnyvale's and Mountain View's contract solid waste haulers, Specialty Solid Waste and Recycling (Specialty), and Foothill Disposal (Foothill), respectively, deliver materials picked-up curbside from residential and commercial (only Mountain View) sources to the Facility five days per week. A breakdown by each city follows.

#### Sunnyvale

Specialty's vehicles collect the following loads throughout Sunnyvale using two-compartment vehicles.

- Five (5) Single-Family (SF) residential routes each day, Monday through Friday
- One (1) Multi-Family (MF) residential route each day, Monday through Friday



## Appendix A

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- One (1) additional Multi-Family residential route on Mondays
- One (1) miscellaneous route for schools/City Hall on Tuesdays

This totals to thirty-two (32) routes per week to cover the entire city. One of the vehicle's compartments contains mixed fibers (newspaper, mixed paper, and cardboard), the other, mixed containers (tin cans, PET, HDPE, aluminum cans, and glass bottles). Both compartments contain some residue, including liquids from closed-top bottles (the fibers compartment usually contains a small amount of containers).

### Mountain View

Foothill's vehicles collect the following loads throughout Mountain View using a mixture of three-compartment and one-compartment vehicles.

- Four (4) residential routes each day, Monday through Friday, over a two-week period (bi-weekly) to cover the entire city
- One (1) additional residential route every other Thursday
- Four (4) commingled commercial routes each day, Monday through Friday
- One (1) commercial old corrugated cardboard (OCC) route each day, Monday through Friday
- One additional commercial OCC route on Monday and Wednesday.

This totals to sixty-eight (68) routes over a two-week period to cover the entire city. The three-compartment vehicles collect commingled containers (tin cans, PET, HDPE, aluminum cans, and glass bottles) in one compartment, mixed paper in a second compartment, and newspapers (newspapers and mixed paper) in the third compartment. The container's compartment contains some residue, including liquids from closed-top bottles. The newspaper compartment also contains some residue as well as some miscellaneous containers. The one-compartment commercial vehicles collect a mix of OCC, mixed paper, and commingled containers; they also contain some residue. The one compartment OCC vehicles collect OCC and contain some level of residue.

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A flow chart of the collection systems for each city is shown in Figures 1 and 2.

Figure 1 | City of Sunnyvale – Collection System

## CITY OF SUNNYVALE

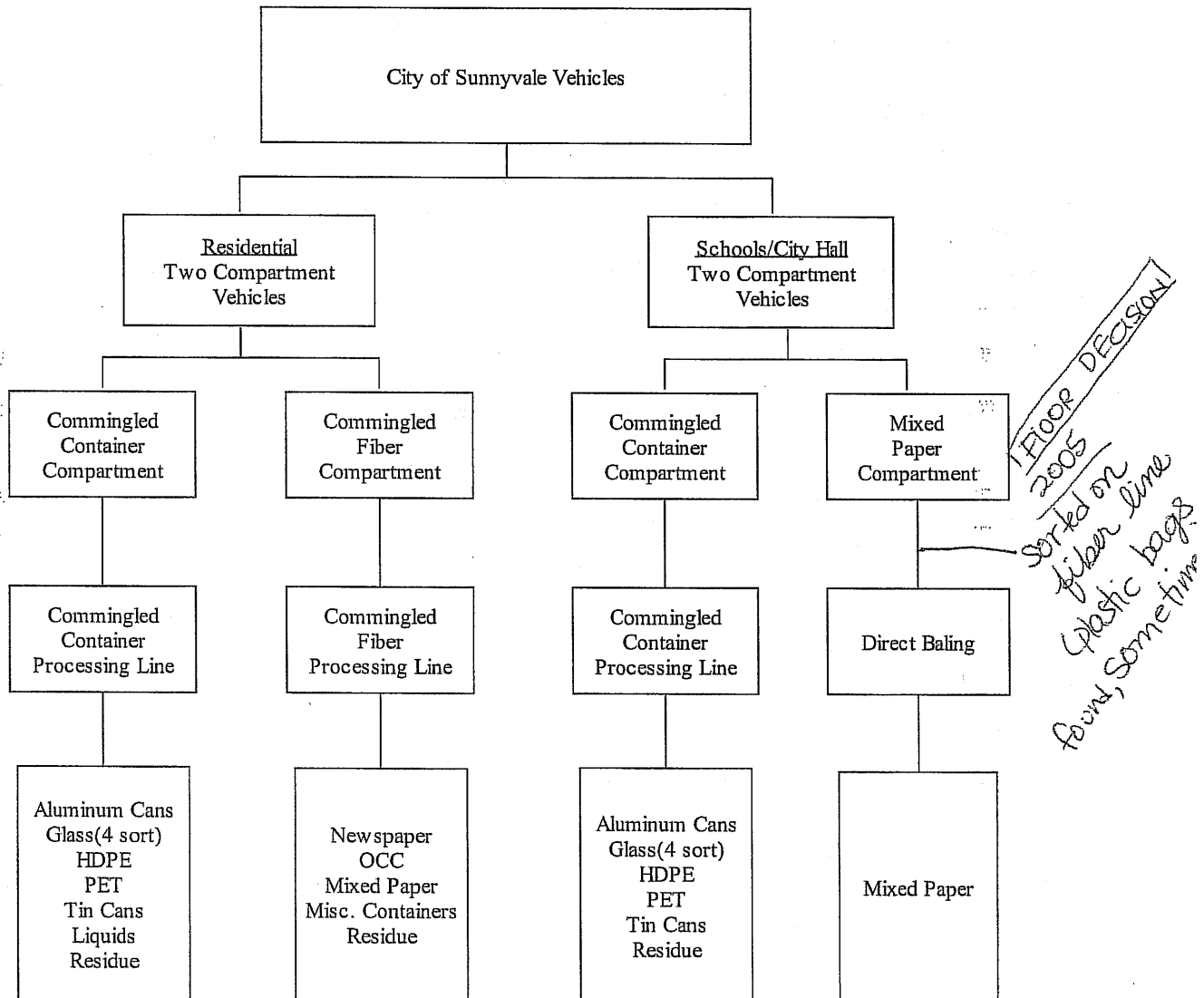
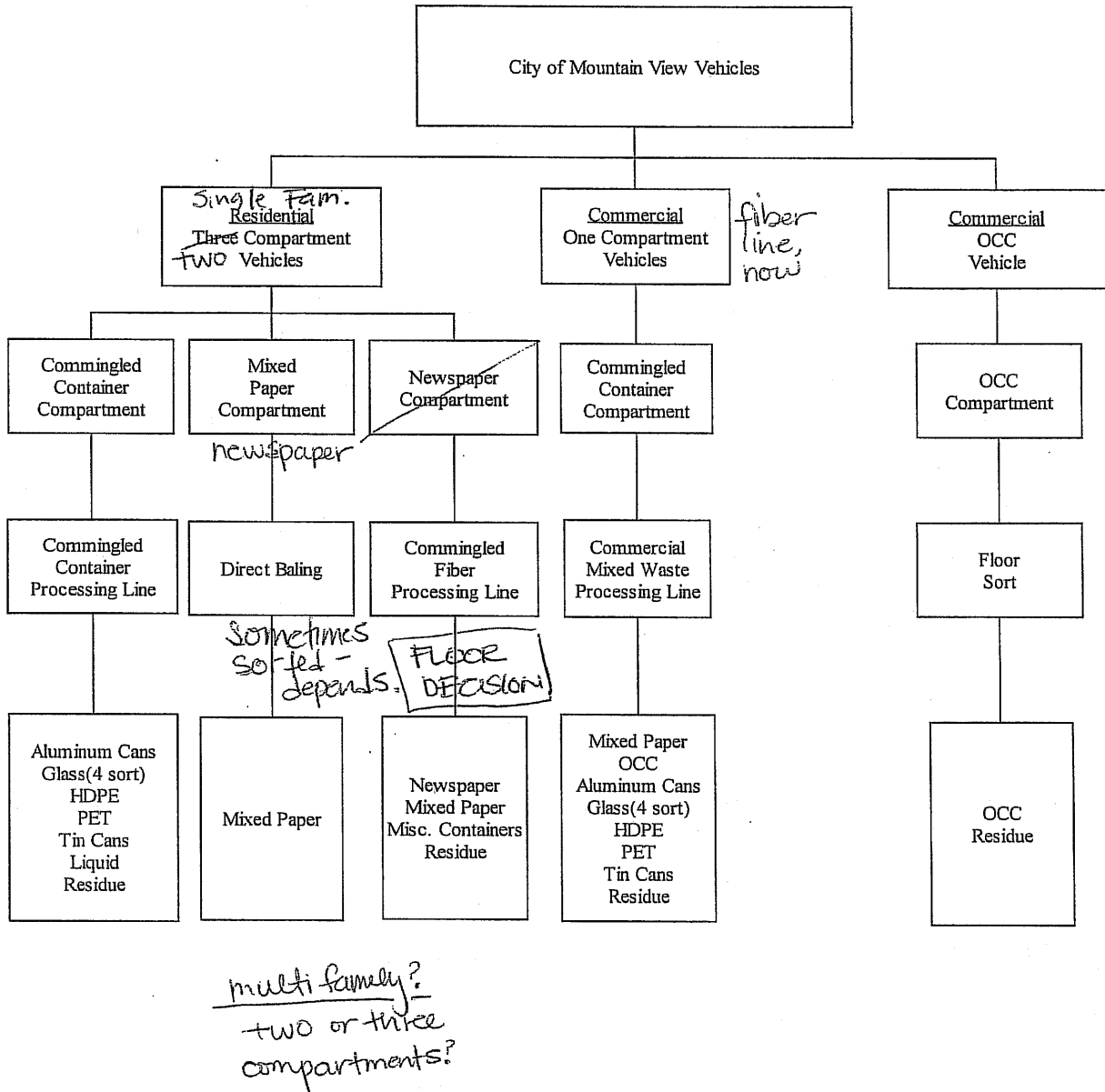


Figure 2 | City of Mountain View – Collection System

CITY OF MOUNTAIN VIEW



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## Processing System

Once the materials are delivered to the Facility, the contract operator, Green Team/Zanker (GTZ) uses three separate processing lines to sort materials; these include the curbside recyclables fiber line, the curbside recyclables container line, and the mixed commercial material processing line from the original NRT processing system. Once materials are processed, they are commingled into like material types for consolidation, delivery and sales to market.

## Physical Work Area

The area adjacent to the processing lines is limited. The bulk of the area is used for receiving, weighing, and unloading of materials from the curbside collection vehicles. There is a small area adjacent to the lines that contain a platform scale and some available space between the scale and the balers for staging materials for weighing.

## Equipment

Most equipment used for this study can be supplied by the Facility, including containers, bins, balers (one connected each to the fiber line and one to the commercial line), forklifts, front-end loaders, radios, the truck scale, and the platform scale. Additional items needed to be supplied outside the Facility include: a laptop computer to log all information from the study, flagging tape, three ½-gallon containers to collect liquids, permanent markers, duct tape, and notebooks. Personal safety equipment such as hardhats, safety vests, goggles, earplugs, etc are supplied by the contractor's crew (this is equipment that they use on a daily basis to perform their jobs).

## Contract Operator

The GTZ contract operator's team is assumed available each and every day of the sort. The team consisted of approximately 36 personnel including approximately 17 curbside line sorter sorters, 15 commercial line sorters, two rolling stock (forklift and front-end loader) operators, one part-time baler operator,



and one floor manager. The normal truck-scale assistant was not usually on duty during our Study (the floor manager recorded scale weights).

## Study Methodology

There are many steps involved in performing a study of the source separated materials composition from each of the cities. Each step is outlined below by section.

### Determination of Number of Samples

The determination of the number of samples to sort is best derived through experience and available reference information. A quantitative method is not available to determine the appropriate numbers of samples to test in a materials sort of the kind required for the cities of Sunnyvale and Mountain View. The California Integrated Waste Management Board (CIWMB) provides guidelines with reference to number of samples recommended for waste characterization studies. The suggested number of samples ranges from 20-40 with a minimum weight of 200 tons varying according to residential, commercial and industrial loads. Please see [www.ciwmb.ca.gov/WasteChar/YourData.htm](http://www.ciwmb.ca.gov/WasteChar/YourData.htm) for further details. It should also be recognized that the stream of materials requiring sorting for this study is recyclables and not waste. However, these are the best guidelines available in the California Solid Waste industry. Combining this with BVA's past experience in material characterization sorts, we suggest that a minimum of 20 samples per city should be analyzed. For the sampling of two cities, a total of 40 samples should be taken. Sampling a total of 40 loads equates to a representation of 40% of the total loads covering the entire population of both cities (100 loads total). This is considered to be significant representation for the study.

### Sample Selection

The total number of loads or routes it takes for Sunnyvale and Mountain View contract collectors to cover the entire area of the cities is 100. This is an accumulation of residential and commercial (Mt. View only) loads throughout both cities. It is important when conducting sample selection to have equal geographic as well as economic representation of each of these waste

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generators. For example, a waste load from an affluent and less populated neighborhood may have a different composition than that of a less affluent and high density area. To ensure that the sampling is not skewed by over or under representation from any one area, discussion of logistics with the haulers to select the preferred routes for sampling and a few alternatives in case additional loads are needed. A random selection process should be used whenever it is possible (after geographic and sector type issues are considered).

To select samples a list of the number of samples required by route type for each city must first be developed. To determine the number of samples required by route type, the total number of routes of a certain type (for example Multi-Family Residential) is divided into the total number of routes in a particular city; this yields a percentage or share of the routes to be sampled. For example, the City of Sunnyvale runs a total of 6 Multi-Family Residential routes per week as part of a total of 32 total routes per week. This equates to approximately 19% of the routes conducted by the City. For a total sample amount of 20 for the city, 19% represents approximately 4 samples that need to be taken from Multi-Family Residential type routes. Table 1 shows the number of samples required by route type and by city for the Study.

After this list is developed, a meeting with the contract haulers from each city is required. In this meeting, the contract hauler should provide a list of when each of these route types is scheduled, associated route numbers, and a map to reference where each route is geographically collected. Using the route list, map and the number of samples by route type, potential routes for sampling should be accumulated. To finalize the routes a random number generator should be used for prioritization. For example, if there are three routes to choose from on a particular day use the random number generator to select from 1 to 3. The first number that is generated is applied to the first route, the second to the second route on the list and likewise with the third route. So if the numbers from the random number generator came up in order 3, 1 and 2, the second route number on the list would be of first priority to sample, the third route of second priority and so on. From this exercise a list showing the preferred routes for sampling





## Appendix A

each day should be generated. The actual route list schedule for the field sampling analysis portion of the Study is shown in Table 2.

**Table 1 | Number of Samples by City and Route Type**

| City/Route              | Number of Routes | Percentage by Routes | Number of Samples |
|-------------------------|------------------|----------------------|-------------------|
| <b><u>Sunnyvale</u></b> |                  |                      |                   |
| SF Residential          | 25               | 78%                  | 15                |
| MF Residential          | 6                | 19%                  | 4                 |
| Schools/City Hall       | <u>1</u>         | <u>3%</u>            | <u>1</u>          |
| <b>Totals</b>           | <b>32</b>        | <b>100%</b>          | <b>20</b>         |
| <b><u>Mt View</u></b>   |                  |                      |                   |
| Residential             | 41               | 60%                  | 12                |
| Commercial              | 20               | 29%                  | 6                 |
| OCC                     | <u>7</u>         | <u>10%</u>           | <u>2</u>          |
| <b>Totals</b>           | <b>68</b>        | <b>100%</b>          | <b>20</b>         |

**Table 2 | Study Route List Schedule**

| Materials Collected on: | Fri 3/21             | Mon 3/24             | Tue 3/25             | Wed 3/26             | Thu 3/27             | Fri 3/28             | Mon 3/31             | Tue 4/1              | Wed 4/2              | Thu 4/3              |
|-------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Delivered to SMaRT on:  | Sat 3/22             | Tue 3/25             | Wed 3/26             | Thu 3/27             | Fri 3/28             | Sat 3/29             | Tue 4/1              | Wed 4/2              | Thu 4/3              | Fri 4/4              |
| 5:00 AM                 |                      | Specialty SF - 703   | Specialty SF - 704   | Specialty SF - 701   | Specialty SF - 702   | Specialty SF - 701   | Specialty SF - 704   | Specialty SF - 705   | Specialty SF - 702   | Specialty SF - 701   |
| 5:30 AM                 |                      | Foothill COM - 11134 |                      | Foothill COM - 11139 |                      | Foothill COM - 11102 |                      | Foothill COM - 11139 | Foothill COM - 11155 | Foothill COM - 11102 |
| 6:00 AM                 | Specialty SF - 702   |                      | Foothill RES - 15096 |                      | Foothill RES - 15097 |                      | Foothill RES - 15097 |                      |                      |                      |
| 7:00 AM                 | Foothill OCC - 18    | Foothill RES - 15097 | Foothill RES - 15095 | Foothill RES - 15098 | Foothill RES - 15095 | Foothill RES - 15098 | Foothill OCC - 18    | Foothill RES - 15098 | Foothill RES - 15095 | Foothill RES - 15096 |
| 8:00 AM                 | Foothill RES - 15096 | Specialty SF - 705   | Specialty 615        | Specialty MF - 706** | Specialty SF - 704   | Specialty SF - 705   | Specialty MF - 707   | Specialty SF - 701   | Specialty SF - 703   | Specialty MF - 706** |
| 9:00 AM                 | Specialty MF - 706   |                      |                      |                      |                      |                      |                      |                      |                      |                      |

## Vehicle Capture Logistics

At the pre-sort meeting with the haulers, as discussed above, a methodology to capture the vehicles must be discussed. In order to keep consistent samples for the study and to minimize interference with day-to-day operations, the haulers should be required to hold the loads overnight and deliver the loads for sorting the following morning. The preferred routes to sample should be determined by the route, vehicle, and SMaRT numbers. The haulers should be informed a week in advance, or earlier if possible, regarding the schedule to hold their loads overnight, if needed. To ensure that desired loads are not dumped, the scale house operator should have a list of the vehicles that are not allowed to dump during the previous day (targeted loads for sampling). As a cross-check, vehicles should be identified prior to unloading in the receiving area. If by chance a vehicle load is missed, a make-up load would need to be scheduled.



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### Sampling Team

The sampling team should consist of three participants: 1) city representation, 2) the contract processor (GTZ in this instance); and 3) the Study management team (BVA in this instance). The following illustrates each party's roles and responsibilities:

#### **City Representative(s)**

The cities representative(s) should be on-site during the field characterization to monitor ongoing activities as well as train for future efforts in replicating the process. Additional responsibilities include: overall management of the project, coordination with the haulers, Specialty and Foothill, and the contract processor, GTZ, and assistance with equipment and information as needed.

#### **Contract Processor (GTZ)**

The SMaRT Station contract processor (GTZ for this initial Study) should provide the day-to-day operations crew. The crew for the initial Study consisted of approximately 36 personnel including approximately 17 curbside line sorters, 15 commercial line sorters, two rolling stock (forklift and front-end loader) operators, one part-time baler operator, and one floor manager. The normal truck-scale assistant was not usually on duty during our Study (the floor manager recorded scale weights). The Study should be conducted using the same number and type of sorters as under normal operations. It is important that the sampling process be as representative of a normal or typical daily sort, as possible. Contractor management should also be available for supervision, equipment and information, as needed.

#### **Study Management (BVA)**

The Study Management Team (BVA in this Study) should be responsible for developing the methodology, providing the training manuals and conducting a training session, managing and running the sort, collecting and aggregating the data, performing a QA/QC check on all data, developing a statistical analysis, and linking the data spreadsheet to Sunnyvale's proration spreadsheets.

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During the field sampling study, the Management Team should provide three to four field managers to assist in training the workers. They should make every attempt to not only help them conduct their part of the work successfully, but to help them understand why it is important to conduct the study in a certain manner. Each of the field managers should have at least a fundamental understanding of the Spanish language.

### Schedule for Sampling Team

The greatest factor in preparing the schedule is to ensure that the sort does not interfere with day-to-day operations of the facility. With this in mind, the sampling team should conduct the sorts early in the morning, preferably beginning at approximately 5 am in the morning. The sample loads should be scheduled from the prior day pick up. For example Friday's loads should be delivered, sorted and weighed on Saturday. Thus, all the sample loads should be from collection routes running Monday through Friday. Plans should be made to sort 4 samples a day over a 10-day period for a total of 40 samples (fewer sorts per day over a longer period is acceptable, as long as they are divided across the weekdays equitably).

### Training for Sampling Team

The sampling team should receive appropriate training. The majority of training should be provided during the actual field sampling study. Training materials should be distributed to all personnel prior to the scheduled field study. These materials should be developed in English as well as Spanish. The English and Spanish versions of the Training Manual are included in Appendix B of this report. On the first day of the field study, management staff should review these training materials with the sort team in both English and Spanish prior to commencement of the sort. Additional processing time may be needed on the first day of the sort to acclimate personnel to the difference in procedures. City representative(s) should also participate in the on-site training to understand the required management for future materials sorts.



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### Maintaining Ongoing Operations

As mentioned above, the sort should be conducted during the non-operational hours of the source separated processing system to ensure that ongoing operations of the Facility are undisturbed.

### Receiving Vehicles and Floor Handling

Vehicles should be received and weighed and a total vehicle/load weight recorded. Materials from the first compartment should then be dumped onto the floor or directly onto the processing system in-feed conveyor. The vehicle should then be re-weighed to record the remaining vehicle weight; a simple subtraction will yield the individual compartment weight. The second compartment (if a 2- or 3- compartment vehicle) should then be emptied onto the floor and then the vehicle re-weighed to record a total weight for that second compartment. The third compartment (if a 3-compartment vehicle) should then be emptied onto the floor and then the vehicle re-weighed to record a total weight for that third compartment. All materials must be kept segregated using placement and flagging tape as necessary prior to sort and weighing to ensure the materials are not contaminated.

By compartment, materials should be processed over the three processing lines described previously, commingled containers over the curbside containers processing line, commingled fibers over the fibers processing line and fully commingled recyclables over the older mixed commercial materials processing line. Some materials, such as newspaper from Mountain View should only need to be “cleaned-up” using a negative sort to pull out mixed paper contaminants. Other materials, such as mixed paper from Mountain View should not need to be processed over a line at all, only weighed and baled.

### Fiber Line Sorting

The normal curbside processing system with the normal allotment of crew should be used for sorting the fiber type materials from each of the loads (from individual truck compartments). The crew should consist of approximately 7 sorters, including the line operator. Loads of mixed fiber materials can contain old newspaper (ONP), old corrugated cardboard (OCC), mixed paper (MP), and

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